Remarks

I. 35 U.S.C. §102

Claim17 stands rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No 5,847,904 to Bharthulwar. The Final Rejection states on page 2, paragraph 2:

> Bharthulwar shows an electromagnetic device in figures 3A-3B that has: a plurality of adjoining active layers (GMR or SV layers, see col. 7, lines 20-21) disposed over a substrate. With regard to the claimed process steps involving the first and second mask layers, a "product by process claim" is directed to the process per se, no matter how actually made. (*citations omitted*). The patentability of the final product in a "product by process" claim must be determined by the product itself and not the actual process and an old or obvious product produced by the new method is not patentable as a product, whether claimed in "product by process" claims or not. Therefore, since independent claim 17 is a product claim, the claimed first and second mask layers involved in the intermediate processing of the sensor are not given patentable weight.

Applicants respectfully disagree that claim 17 includes process steps. Claim 17 is reproduced below to illustrate that no process steps are claimed:

> 17. An electromagnetic device comprising:
> a plurality of adjoining active layers disposed over a substrate,
> a mask disposed over said active layers, said mask having upper and lower mask layers, said upper layer having a first thickness and said lower layer having a second thickness,
> said lower mask layer having a plurality of regions adjoining one of said active layers, with a void separating said regions,
> said upper mask layer adjoining said regions and extending as a bridge over said void, said bridge having a length measured between said regions and a submicron width measured perpendicular to said length and to said first thickness.

Appellants respectfully assert that "the claimed first and second mask layers" are structures, not processes, and therefore should be "given patentable weight."

The Final Rejection states, on page 4, paragraph 6:

> The mask layers are not included in the final product (mask layers 207,208 are removed during the processing steps, see paragraphs 37-39 of Applicant's disclosure). Therefore, the mask layers are inherently part of process steps which form the final product. A "product by process" claim is directed to the product per se, no matter how actually made (i.e., made

> by the mask layers during the processing steps) and the patentability of the final product in a "product by process" claim must be determined by the product itself and not the actual process steps involved.

Claim 17, however, does not recite a "final product," but rather an "electromagnetic device" that includes mask layers.

Applicants respectfully assert that Bharthulwar does not disclose the mask layers recited in claim 17, and that the Final Rejection has not presented a prima facie case of anticipation of claim 17 over Bharthulwar.

II. <u>35 U.S.C. §103</u>

Claims 10-16 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No 5,847,904 to Bharthulwar. The Final Rejection states, in part:

> Bharthulwar shows an electromagnetic device in figures 3A-3B that has: a solid body having a leading end separated from a trailing end in a lengthwise direction, a media-facing surface separated from a non-media-facing surface in a heightwise direction, and a pair of sides separated from each other in a widthwise direction, a plurality of adjoining sensor layers (GMR or SV) extending adjacent to said media-facing surface, a pair of serpentine, wineglass shaped electrically conductive leads 74,76 (magnetic when *including longitudinal bias layers* 66,68) disposed adjacent to said media-facing surface and separated from each other by a track width "TW", at least one of said leads having a height measured in said heightwise direction, wherein said height measured at a first location (fig. 3A, far outer edges of leads 74,76) that is distal to said track width is at least twice (4 times, cl. 12) said lead height "h" measured at a second location that is adjacent to said track width "TW". However, Bharthulwar is silent as to the TW width (cl. 10, a range between .25 microns and 1 nm).
>
> Hawakawa et al shows an MR head in figure 1 that has a track width of 0.28 microns defined between the leads 16 (see col. 8, line 9).
>
> Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make the track width of Bharthulwar a submicron width (0.25 microns) as doing this would permit reading of narrow tracks, thus improving the storage capability of the overall storage device by improving the recording density of storage.

Applicants respectfully disagree that "it would have been obvious to one of ordinary skill in the art at the time the invention was made to make the track width of Bharthulwar a submicron width (0.25 microns)." The track width "TW" dimensions of

Bharthulwar is not explicitly stated, but it is apparent from Fig. 3A of that reference that the track width "TW" dimension is at least as large as the height "h," which is stated to be 5 microns (column 5, lines 25-26).

One of ordinary skill in the art would have had difficulty scaling the 5 micron track width of Bharthulwar to the very much smaller dimensions recited in claim 10 (between 0.25 and 0.001 microns) for several reasons. Initially note that Bharthulwar has a number of layers with different dimensions in the track width direction, each of which would presumably need to be defined by a different mask, and alignment of the multiple masks would become increasingly difficult as the track width is reduced. For example, Fig. 3B of Bharthulwar shows layers 94 and 96 that terminate at a first distance in the track width direction, which would presumably require a first mask. MR sensor 62 terminates at a second distance in the track width direction, which would presumably require a second mask. Conductors 74 and 76 terminate at a third distance from each other in the track width direction, which would presumably require a third mask.

Each mask implies performance of several steps, including applying a photoresist layer, positioning a template over the photoresist layer, exposing the photoresist layer that is not covered by the template, removing the undeveloped photoresist, etching the device layers that are not covered by the mask, and removing the mask. Most if not all of those steps introduce an uncertainty in the track width dimension of the feature being defined, and the uncertainties generally do not scale with the decreased device size. Thus to scale the several masks of Bharthulwar smaller by a factor of at least 20 and as much as 5000 would likely result in misalignment of the layers defined by the masks, the misalignment destroying the function of the sensor.

Moreover, Bharthulwar's conductor layers 74 and 76 are essentially flat, and are disposed atop an essentially flat surface, including the top of bias layers 66 and 68 and sensor 62. To achieve this essentially flat surface after defining several of the layers as described above requires that the top of bias layers 66 and 68 and sensor 62 have been polished, which implies a further difficulty in reducing the scale of Bharthulwar. If the surface beneath conductors 74 and 76 of Bharthulwar were not polished, additional uncertainties would be present in the definition of conductors 74 and 76, further arguing against reducing the scale of Bharthulwar to where it would approach the track width

recited in claim 10, especially in view of the many masks. Polishing the surface of MR sensor 62, however, would be expected to damage the sensor, unless the sensor or a cap layer of the sensor is relatively thick. A thick sensor would have a low resolution, and the resolution lost by having a thick sensor would likely outweigh the resolution gained by having a narrow track width. This is because the resolution in the track length direction is primarily governed by the spacing between the shields, that spacing limiting the magnetic fields that reach the sensor to the fields that originate from the portion of the recorded track located closest to the sensor. In the track width direction, however, the shields do not intercept stray magnetic fields, so that having a smaller track width does not necessarily keep the sensor from sensing fields that originate in adjacent tracks.

Hamakawa et al. is not particularly helpful in teaching how to reduce a sensor's the track width, as Hamakawa et al. is primarily directed to reducing the read gap thickness, which is generally independent of the track width. Although Hamakawa et al. states "the width of track of read head was set to 0.28 μm" (column 8, lines 8-9), and "The width of track of read head was set to 0.3 μm" (column 7, lines 8-9), Hamakawa et al. does not teach how to achieve such a narrow track width. For instance, Hamakawa et al. states "The domain control film 15 and electrodes 16 were formed by means of a lift-off method which was known in the art" (column 5, lines 8-10). Regarding FIG. 6, for which "The width of track of read head was set to 0.3 μm," Hamakawa et al. states "A domain control film 48 was formed on both sides of the magnetoresistive film 41, and an electrode 47 was formed on each of the domain control films 48" (column 6, line 67 - column 7, line 3). Regarding FIG. 7, for which "the width of track of read head was set to 0.28 μm," Hamakawa et al. does not indicate how to make such a narrow track width.

Hamakawa et al. does state, however, that "it is considered that the employment of the magnetoresistive head of the present invention is imperative for a magnetic storage apparatus having a recording density of 40 Gbit/in^2 or more." Thus one of ordinary skill in the art reading Hamakawa et al. would not wish to change the shape of the electrodes 47 shown in FIG. 6 of Hamakawa et al. to those of Bharthulwar, especially when Bharthulwar has so many apparent problems in scaling to smaller dimensions.

Assuming arguendo that one of ordinary skill in the art would have somehow modified Bharthulwar to realize the dimensions stated in Hamakawa et al., those

dimensions would still be significantly different than the dimensions recited in amended claim 10. Additionally, all of the difficulties and disincentives mentioned above would have become more onerous, had one of such skill attempted to achieve the invention actually defined by claim 10.

Regarding claims 11 and 15, applicants respectfully disagree with the Final Rejection's assertion that Bharthulwar discloses "electrically conductive leads 74,76 (magnetic when including longitudinal biasing layers 66,68)." Bias layers 66 and 68 of Bharthulwar are not part of electrically conductive leads 74 and 76, and appear to be bypassed in the current flow through the device "active region 64," as would be expected due to the much higher resistance of bias layers 66 and 68 compared to electrically conductive leads 74 and 76.

For at least these reasons, applicants respectfully assert that claims 10-16 are not obvious over Bharthulwar as proposedly modified by Hamakawa et al.

III. Allowed Claims

Applicants appreciate the allowance of claims 1-9 and 23-26.

IV. Conclusion

Applicants respectfully request consideration of the claims at issue in view of the above remarks. Applicants believe that the claims are in condition for allowance, and a Notice of Allowance is solicited.

Respectfully submitted,

Mark Lauer
Reg. No. 36,578
6601 Koll Center Parkway
Suite 245
Pleasanton, CA 94566
Tel: (925) 484-9295
Fax: (925) 484-9291

CERTIFICATE OF FACSIMILE TRANSMISSION
I hereby certify that this correspondence is being transmitted via facsimile to MS AF, Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450, telephone number (703) 872-9306, on June 11, 2004.

Date: 6-11-04

Mark Lauer